

User Tools for Autonomous Systems

GSFC / SOMO Technology Development Program Annual Review

Julie Breed

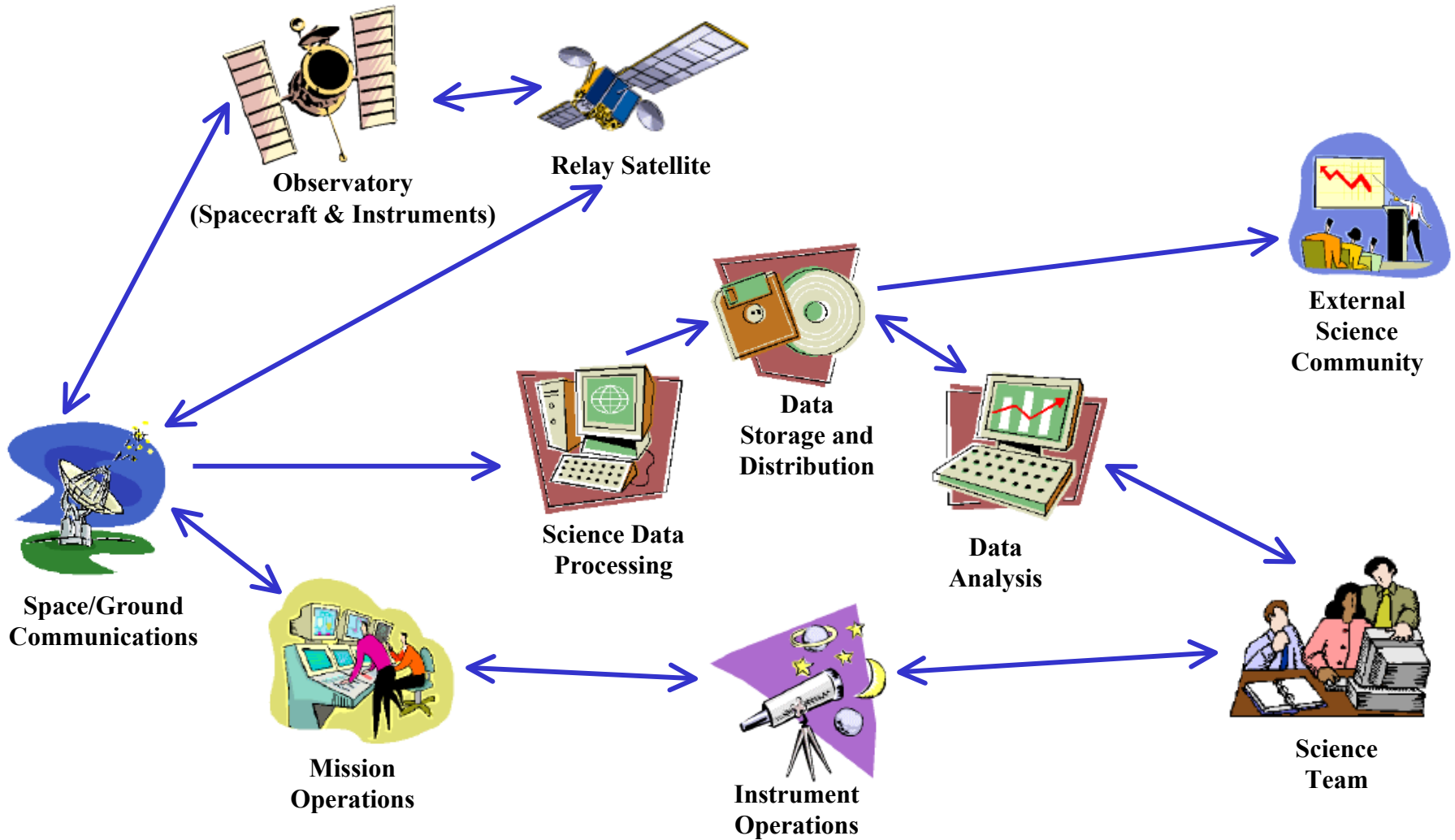
September 19 - 20, 2001



Agenda

- **Work Area Overview**
- **Scientist Expert Assistant's (SEA)**
- **Virtual Mission Operations Center (VMOC)**
- **Advanced Visual Tool and Architectures (AVATAR)**
- **Information Visualization (InVision)**
- **Scientist Mission Assistant and Research Tool (SMART)**
- **Software Engineering Lab (SEL)**

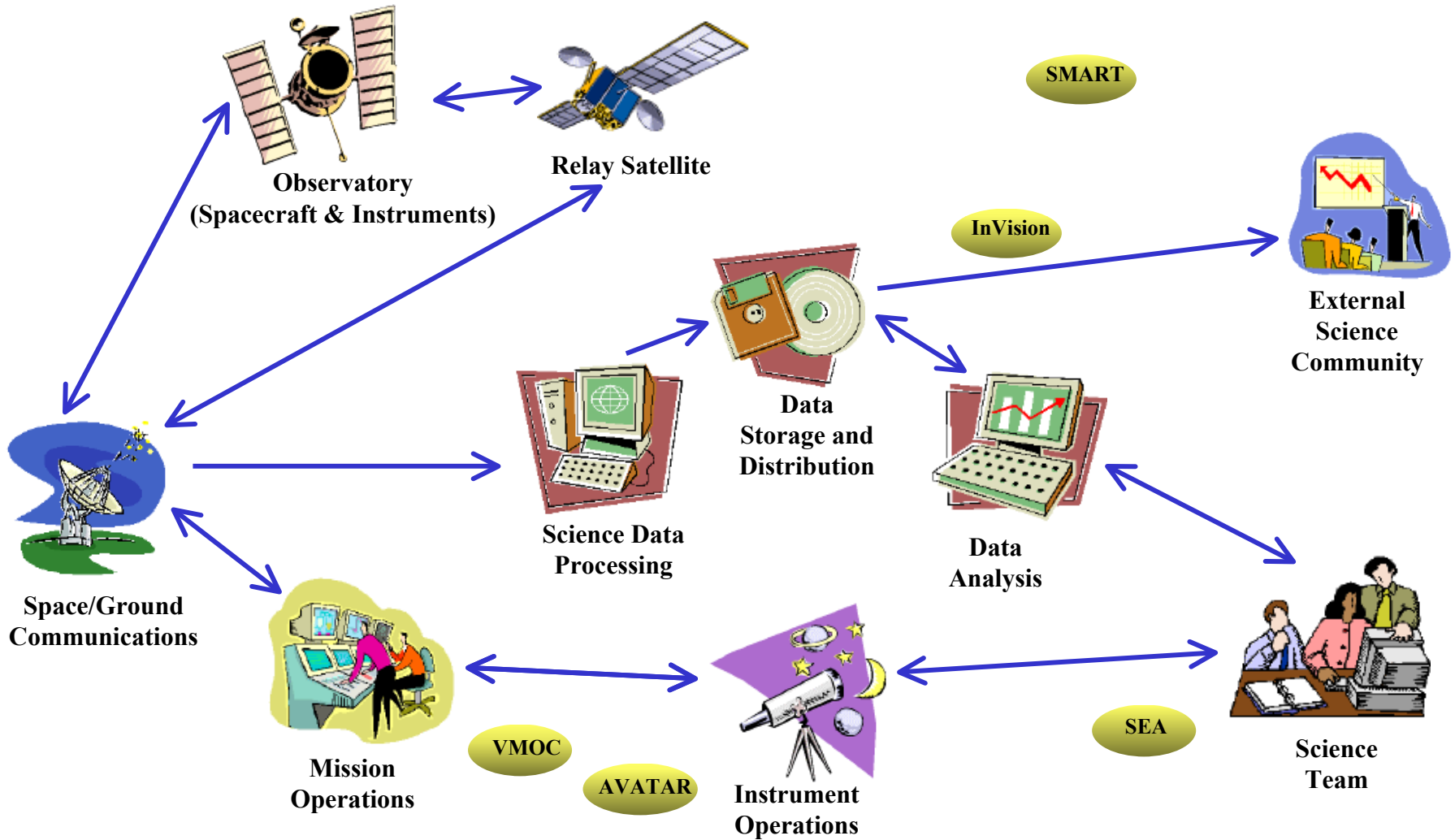
User Tools for Autonomous Systems



User Tools for Autonomous Systems

- **Objective**
 - Design and develop advanced tools that provide end users with capability to plan, operate and visualize activities from remote locations. These tools will allow the end-user to produce engineering and science data visualizations that analyze mission and operations performance, to reduce the time and effort preparing observatory proposals, and to produce more efficient mission designs.
- **Work is being performed the areas of :**
 - Observation Specification
 - Remote Notification and Engineering Data Access
 - Architecture for Distributed Mission Services
 - Interface for Ordering Services

User Tools for Autonomous Systems

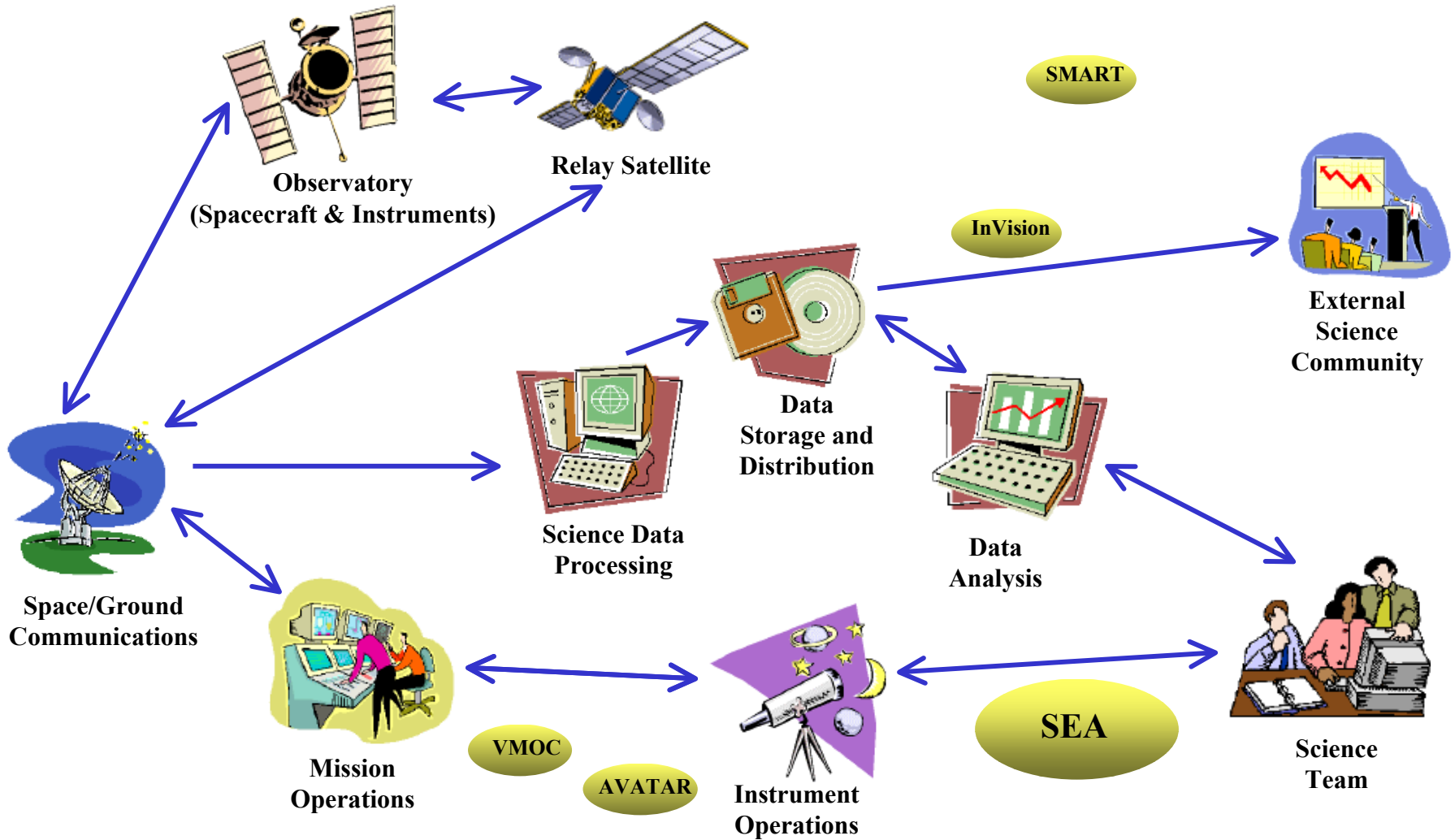


User Tools for Autonomous Systems

External Coordination

Task	Partnership & Collaborations	Infusion and/or Transfer Plans
Virtual Mission Operations Center	GSFC Code 731, Systems Engineering Support Services and Advanced Concept Branch	ULDB SMEX MIDEX ESDIS
Advanced Visual Tools and Architecture		ST-5 SMEX AFRL Large constellations
Information Visualization	University of Virginia - Prof. Scott Acton at the University of Virginia. GSFC 0 Digital Library for Earth System Education (DLESE)	SEE, Code 900 CIPE Educators JPL's MIPL
Scientist Mission Assistant Research Tool	CSOC Customer Service organization, Sandia National Labs - Dr. Ernest Friedman-Hill	JSC - SLA & Services Catalog Management Organization
Scientist's Expert Assistant	Space Telescope Science Institute (STScI)	STScI SOFIA VLT Gemini NGST

Scientist's Expert Assistant (SEA)

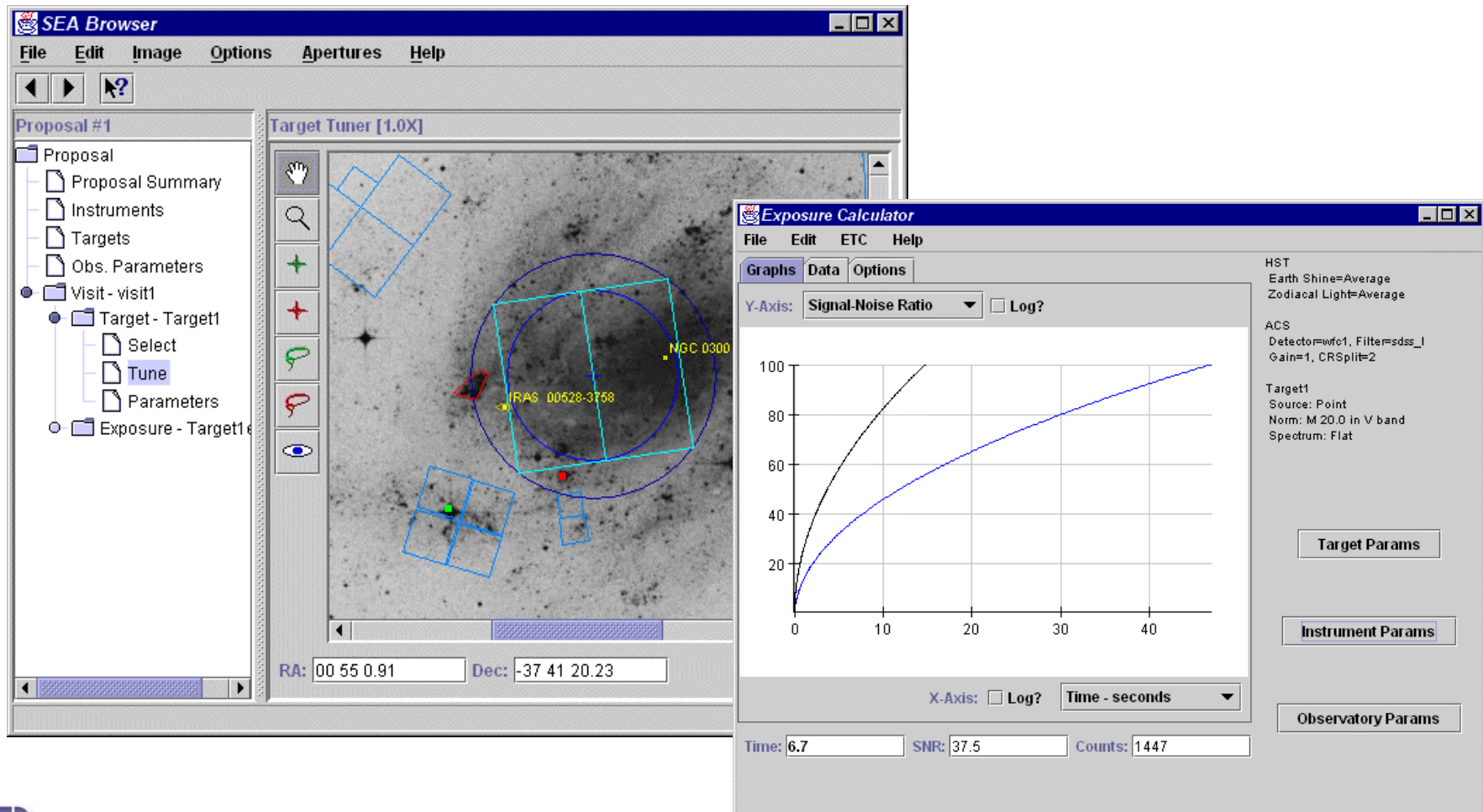


Scientist's Expert Assistant (SEA)

- **Summarized Description**
 - Intelligent software interface to guide a scientist through the specification of an observation in scientific terms rather than mission parameters; simulation tool to validate specification prior to scheduling and execution.
- **Background / Need**
 - Due to mission complexity, practically all science requests are received with one or more errors, which brings mission planning manpower into a costly iterative process.
- **Benefits**
 - Reduce the cost of mission operations by improving the accuracy of science requests, and decreasing the time spent in iteration and re-planning
 - Increase the efficiency of mission resource utilization by eliminating errors and rework
 - Provide a front-end window for scientists to a fully autonomous mission control system
- **Potential Customers: HST, NGST, Space Telescope Science Institute, SOFIA, VLT, Gemini**

Scientist's Expert Assistant (SEA) Overview

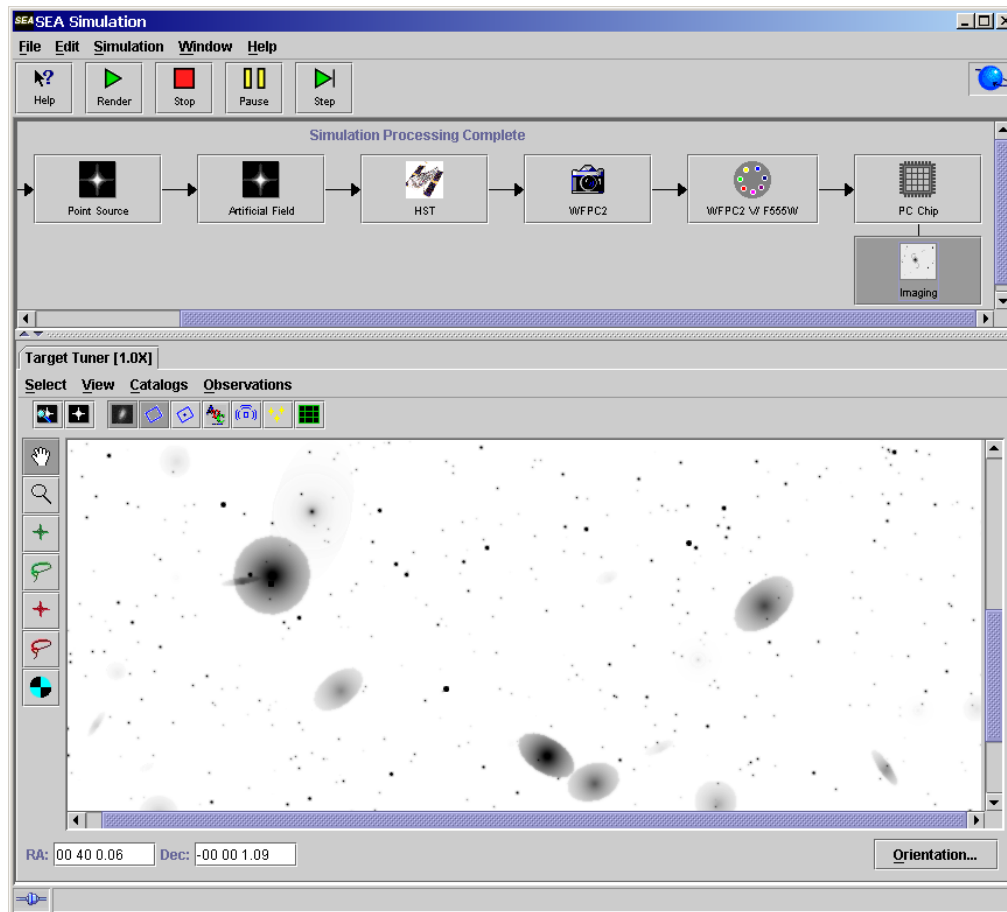
The SEA is the front end of a black-box autonomous mission control system which enables the scientist to specify his/her goals. The SEA is an intelligent software interface to guide an astronomer through the specification of an observation in scientific terms rather than mission parameters. It has been infused and is being used at the STScI.



Scientist's Expert Assistant (SEA)

Simulation Facility Overview

- Simulates observations to determine data quality early in the process
- Helps discover errors in observation specification prior to scheduling
- Decreases likelihood of failed observations (wasted mission resources)

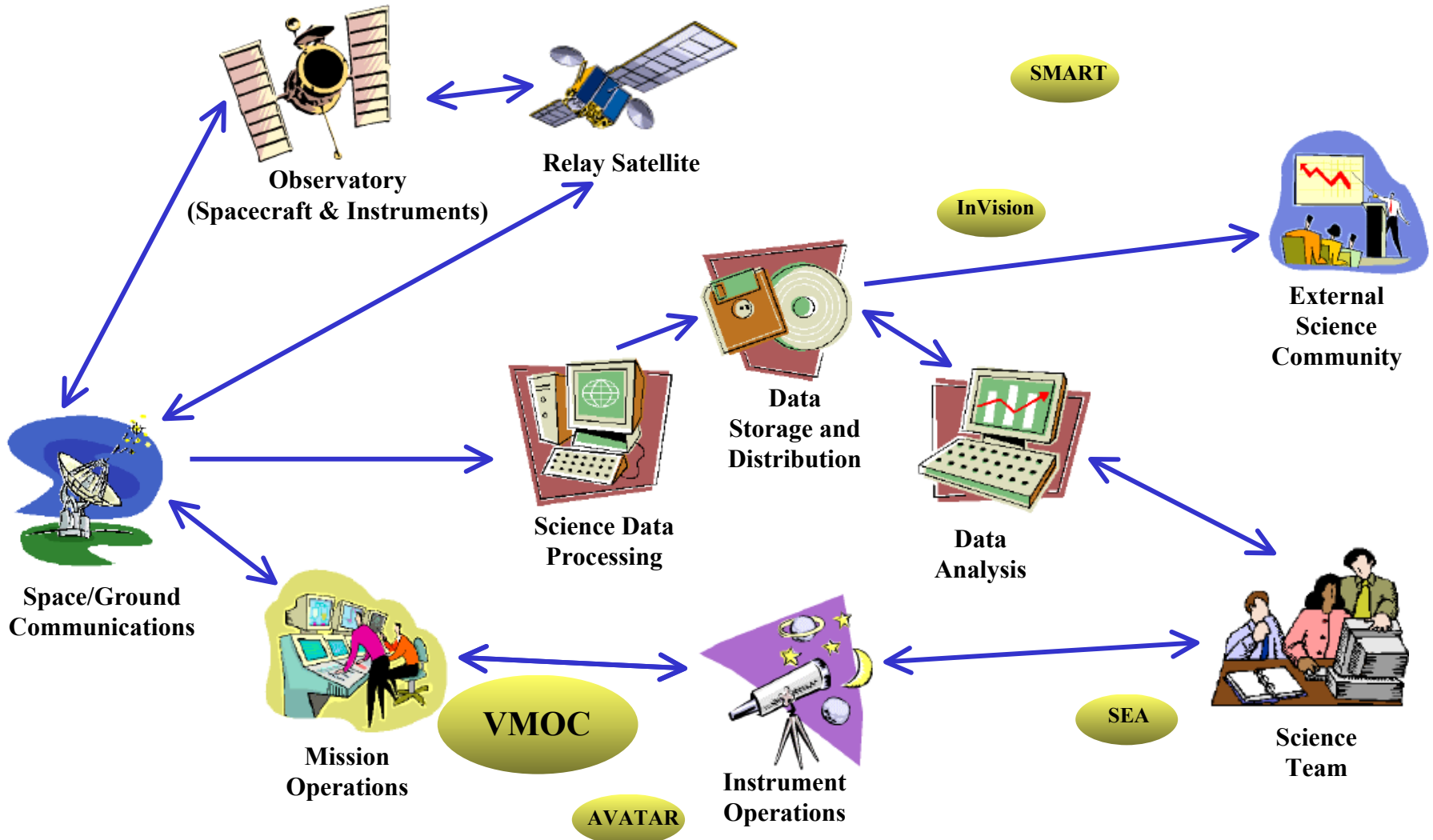


SEA

FY01 Accomplishments / Plans

- **FY01 Accomplishments**
 - SEA Simulation Prototype 2
 - Presented SEA Simulation prototype to the Astronomical Data Analysis Software and Systems conference
 - 1SEA Simulation Prototype 3
 - SEA Simulation Prototype 4: support for spectroscopy visualization
 - SEA Simulation Prototype 5: remaining simulation models
 - SEA Phase I received NASA Software of the Year Award Honorable Mention for FY01
- **FY 01 Plan vs. Actual Deviations (since semi-annual review)**
 - All work as proceeded as planned.
- **Planned Accomplishments for FY02**
 - Task was scheduled to complete in FY03
 - Task is cancelled
 - Developing proposals for ROSS AISR and HST infusion

Virtual Mission Operation Center (VMOC)



Virtual Mission Operations Center (VMOC)

Collaborative Environment (CE) Overview

- **Summarized Description:**

- The Collaborative Environment will enable operators to interact with the control center and each other from remote locations to
 - increase the efficiency with which they are able to resolve anomalies
 - minimize the number of times that they must report to the physical control center.

- **Background / Need:**

- The mission operations staff will save time and be able to respond more quickly to anomalies that occur if they can interact with the control center from remote locations. Pass times are often too short for an operator to drive into work and resolve the problem on a current pass.
- Building a distributed collaborative framework will also allow Project Managers and Scientists to interact with operations to obtain information regarding mission status.

- **Benefits / Metrics:**

- Reduce mission operations manpower
- Enable more robust lights-out operations, including commanding
- For simple missions, enable 3-shifts lights-out (currently only 2)
- For complex missions, enable single-shift lights out (currently none)
- Improve efficiency of work by enabling work on-center, but out of control room (in offices)

- **Potential Customers: SMEX, ESDIS, ULDB, MIDEX**

Virtual Mission Operations Center (VMOC) Collaborative Environment (CE) Overview

VSDE Portal - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Stop

Bookmarks Location: What's Related

Instant Message WebMail Contact People Yellow Pages Download Channels

Start Logout

Chris Stone
IMDC / Administrator

[Portal](#) [Collaborate](#) [Project Mgmt.](#) [\[Change Colors \]](#)

[Customize](#) [Content](#) [Layout](#)

Explore

- ATS
- IMDC
- MeetingPlace
- Test
- Action Item Database
- ISAL
- Earth Science
- Space Science
- Environet
- Aeosat/NGST Calendar

Site Directory

- Home
- Search
- Help
- Administration
- Tools
- Change Personal Info.

Personal Workspace

- Email
- Tasks
- Address Book

Collaborate

Beaman, Bob:	bbeaman@pop700.gsfc.nasa.gov	AOL IM	Netmeeting
Colborn, Adrian:	acolborn@staac-mail.gsfc.nasa.gov	AOL IM	Netmeeting
Ericsson-Jackson, Aprille:	aejackso@pop500.gsfc.nasa.gov	AOL IM	Netmeeting
Estes, Bob:	bestes@code713.gsfc.nasa.gov	AOL IM	Netmeeting
Everett, Dave:	David.F.Everett.1@gsfc.nasa.gov	AOL IM	Netmeeting
Herring, Ellen:	ellenh@rattler.gsfc.nasa.gov	AOL IM	Netmeeting
Martin, John:	jmartin@pop400.gsfc.nasa.gov	AOL IM	Netmeeting
Moore, Corina:	Corina.Moore@gsfc.nasa.gov	AOL IM	Netmeeting
Palace, Dave:	dpalace@pop700.gsfc.nasa.gov	AOL IM	Netmeeting
Peters, Dave:	dpeters@mscmail.gsfc.nasa.gov	AOL IM	Netmeeting
Roach, George:	groach@mscmail.gsfc.nasa.gov	AOL IM	Netmeeting
San, Josephine:	jsan@pop200.gsfc.nasa.gov	AOL IM	Netmeeting
Stone, Chris:	stone_chris@bah.com	AOL IM	Netmeeting
Yun, Diane:	dyun@pop700.gsfc.nasa.gov	AOL IM	Netmeeting

Document: Done



VMOC CE

FY01 Accomplishments / Plans

- **FY01 Accomplishments to Date**

- Compiled operations processes and delivered White Paper
- Developed two operational scenarios
 - Real time use for the ULDB mission
 - Generic anomaly to be tested with SMEX or MIDEX operators
- Completed proof of concept prototype for VMOC-CE
- Beta tested CE prototype as remote sites
- Delivered Release 1.0 of VMOC-CE
- Demonstrated CE to ESDIS
- Delivered Java Application Shell (JAS) Release 1.0
- Delivered JAS Release 2.0
- Significant software reuse: I2K, JOIN, and CE contributed to JAS; ASTAT, REACH, and GOC will use JAS

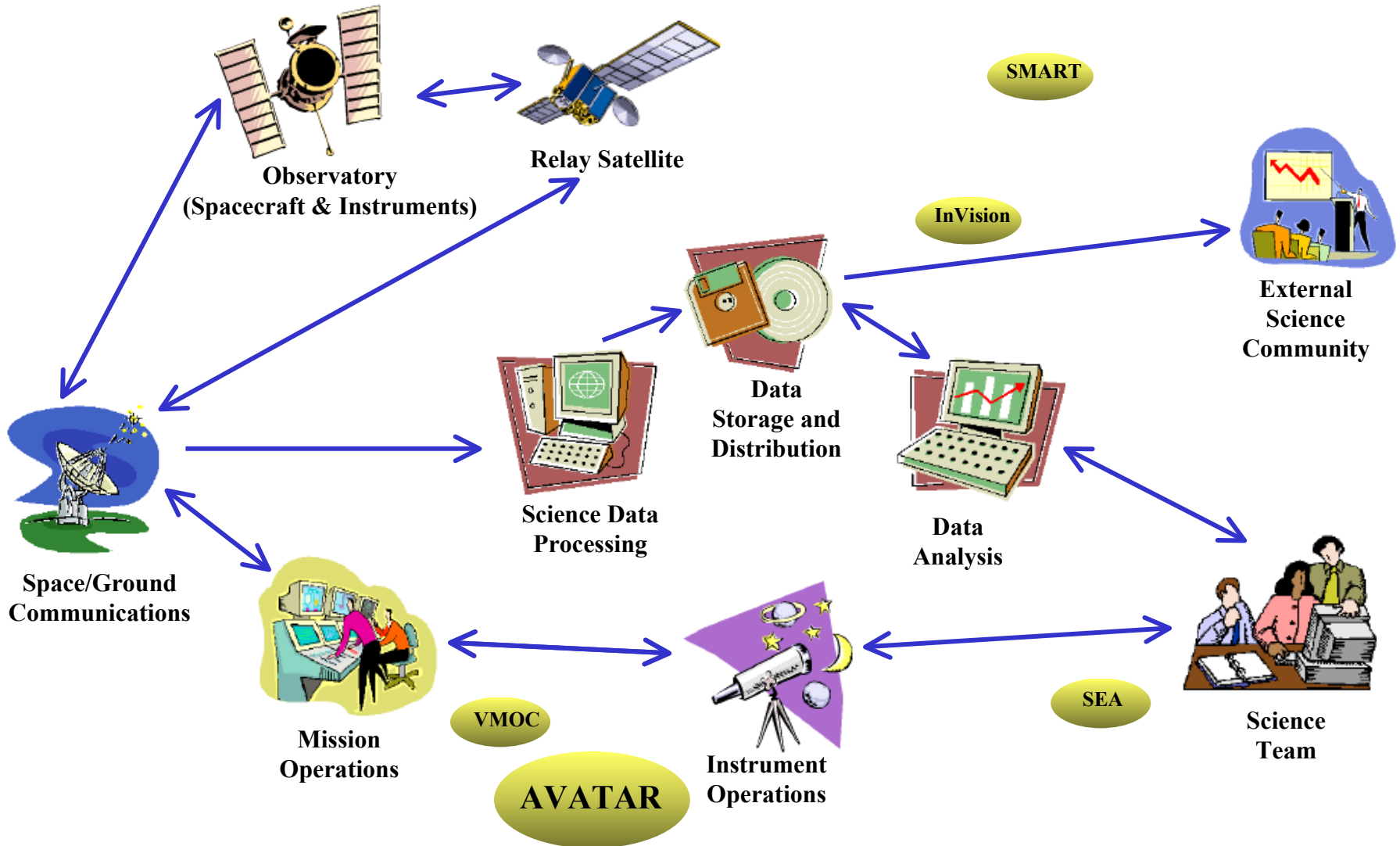
- **FY 01 Plan vs. Actual Deviations**

- Actual work has proceeded on plan .

- **Planned Accomplishments for FY02**

- Task was scheduled to complete in FY04
- Task is cancelled
- Developing proposal for ESDIS infusion

Advanced Visual Tools and Architectures (AVATAR)



AVATAR Real-time Evaluation and Analysis of Consolidated Health (REACH) Overview

- **Summarized Description:**
 - The Real-time Evaluation and Analysis of Consolidated Health (REACH)* Tool will provide concise, intuitive visualizations of health models for multi-spacecraft missions, to enable consolidated mission operations.
- **Background / Need:**
 - Currently, the flight operations staff often view data in a table format. These displays are very busy and important information can be overlooked. Further, this format will not scale well when displaying larger amounts of data from a fleet of spacecraft. Current displays for a single spacecraft take up an entire screen.
 - Ordering information to draw attention to the most important features of the data will allow operators to assimilate more information in a shorter time.
- **Benefits / Metrics:**
 - Enable cost reduction via consolidated services
 - Enable cost-effective mission operation for constellations
- **Potential Customers: SMEX, ST-5, Large constellations, AFRL**

AVATAR Overview

Example of Traditional Display

ST O L (ITOS Release 6-14 patchlevel 5)

prompt

*** MIMU Ave Monitor ***
 MIMU -15V 0.0000 vol
 MIMU -750V 0.0000 vol

*** MIMU Ave Val of Analog ***
 *** Ground Voltage Monitor ***
 GRYNOCBNV 0.0000 vol

GMT: 00-222-17:24:56.10
 Last Update: 68-145-00:00:00.00

EC CMD
 MEB CMD

Master Channel

Virtual Channel

Frame counter 63 FRM
 frames received 333 FRM
 frames rejected 0 FRM
 TF version errs 55 FRM
 s/c id errs 297 FRM
 TF sequence errs 0 FRM
 TF CRC errs 0 FRM

Virtual Channel 0

Virtual Channel

Frame counter 128 FRM
 frames received 333 FRM
 frames rejected 0 FRM
 TF version errs 55 FRM
 s/c id errs 297 FRM
 TF sequence errs 325 FRM
 TF CRC errs 0 FRM

Virtual Channel 1

Virtual Channel

Frame counter 0 FRM
 frames received 0 FRM
 frames rejected 0 FRM
 TF version errs 0 FRM
 s/c id errs 0 FRM
 TF sequence errs 0 FRM
 TF CRC errs 0 FRM

Virtual Channel

Frame counter
 frames received
 frames rejected
 TF version errs
 s/c id errs
 TF sequence errs
 TF CRC errs

Packet Reassem

pkts reassembled
 idle packets
 filled packets
 uncompleted pkts
 pkt seq errs
 pkt length errs
 Frame Input Rate

niengdat

*** NISTAR Engineering Data ***

GMT Time 00-222-17:24:53.19023
 Pkt 86 Time 00-221-14:51:53.09275 Pkt 86 Cnt 584

*** RC1 *** *** RC2 *** *** RC3 *** *** HS ***

PTC Resistance Setpoint Cnd 18324491 15374163 15423835 15473506
 PID2 P 17123382 23894371 34247174 47669152
 PID2 I 17333100 24044089 34666611 48088588
 PID2 D 17542819 24253808 35086048 48508025
 PID2 K Loop 17752537 24463826 35505484 48927462
 BNOM Scale Factor 17962256 24673244 35924921 49346899
 MDAC Scale Factor 18171974 24882963 36344358 49766336
 Heater Scale Factor 18381692 25092681 36763795
 Differential Mode Scale Factor 18591411 25302400 37183232 50605209
 BNOM Offset 18801129 25512118 37602688 51024646
 Heater Offset 19010848 25721836 38022105
 MDAC Offset 19220566 25931555 38441542 51863520

niestar

PAGE = NISTAR GMT: 00-222-17:24:56.22

CLEAR MASTER PAGE

*** Nistar Master Display Page ***

PAGES

Housekeeping
 Eng. Data
 Ground Cmd
 Htr Science Data
 Memory Dump
 Misc Eng Data
 Motor Current
 Motor Data/Status 1
 Motor Data/Status 2
 Photodiode Data
 Precharge Values
 Peak Values
 Raw Sci Data
 Shutter Status

Page Buttons

PROCEDURES

NICALFW
 NICALSHUT
 NIMCNDTRESET
 NIDIFFMODECTRL
 NIERASETBL
 NIFIXCLOSE
 NIFIXOPEN
 NIHKCTRL
 NIINSTMODE
 NIINTSHUTPOS
 NIINTWHLPOS
 NIMEDUMP
 NIMODECMD
 NIMTRCTRL
 NIMTRCNRST

Plot Buttons

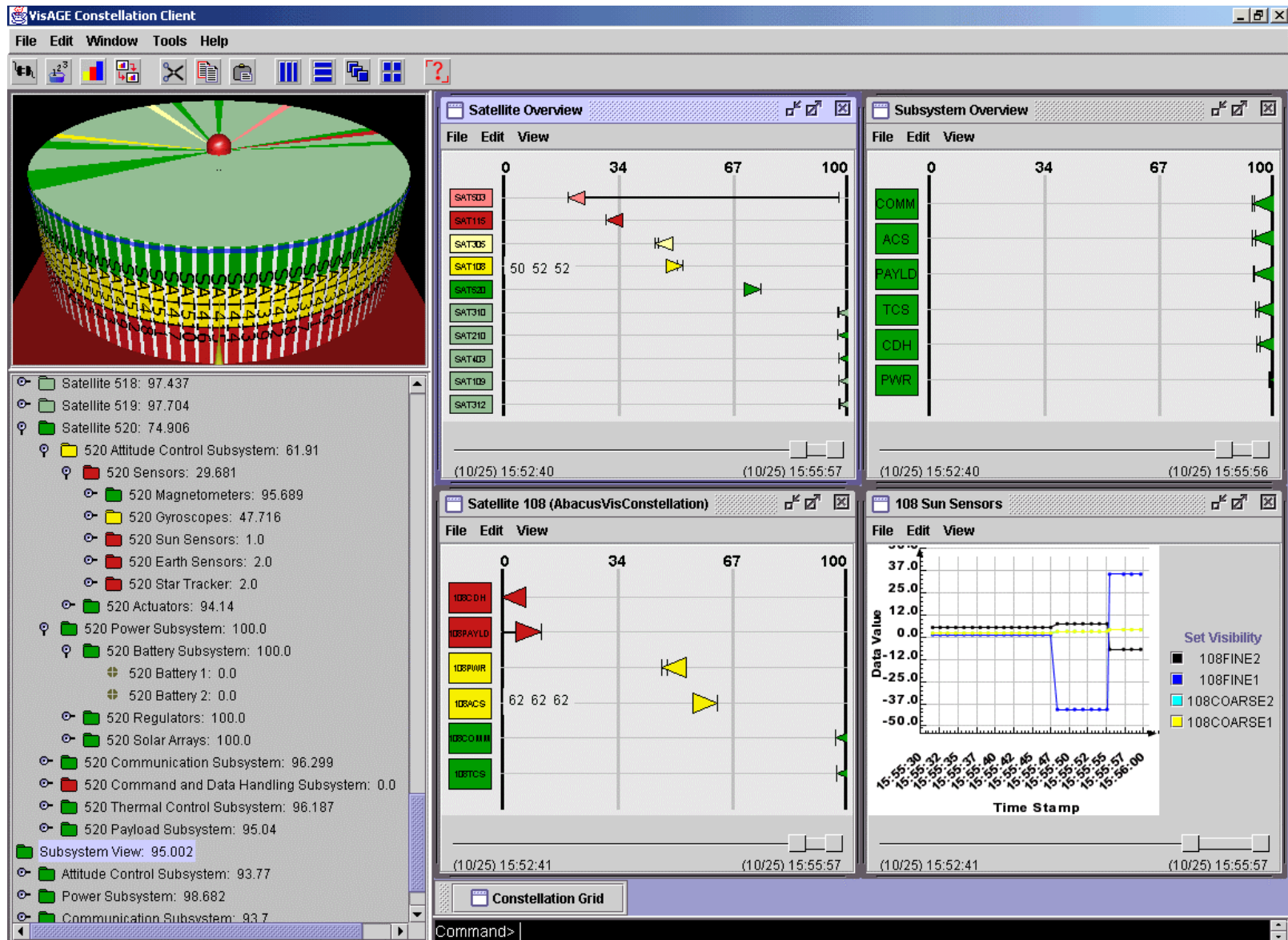
SHTRSCI
 HSLVPSTMP
 POFWMTRTMP
 POWER
 POKERLONG
 PTC
 PTCLONG
 PWA1TMP
 PWA2TMP
 PWATEMP
 RC1HTRSCI
 RC2HTRSCI
 RC3HTRSCI
 RCMTTMP
 VOLTAGE

LIS result
 Att star cnt 0
 LIS Frame Cnt 18

One
 Two
 Three
 Four
 EXIT

AVATAR Overview

Example of REACH Display

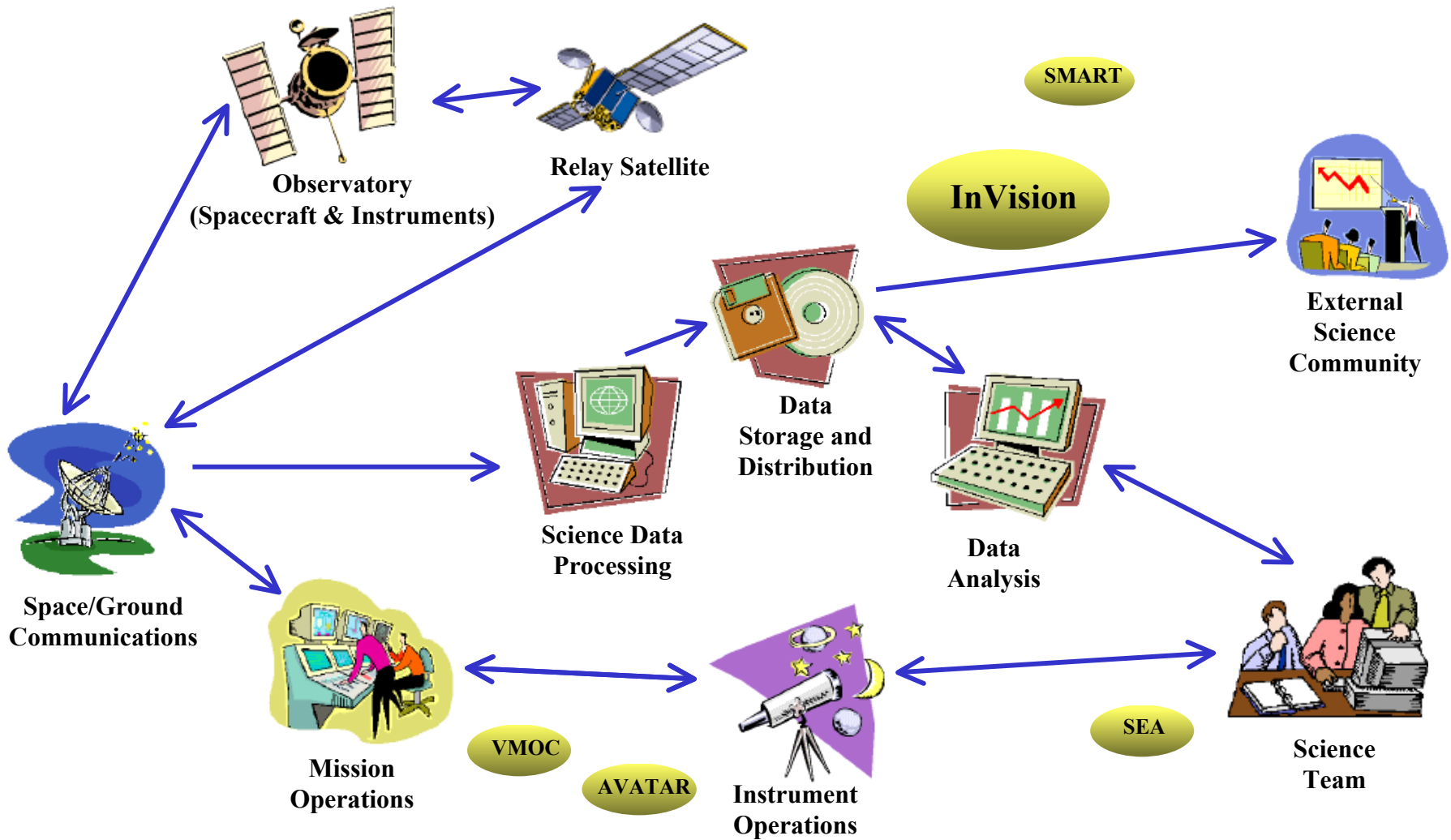


AVATAR REACH

FY01 Accomplishments / Plans

- **FY01 Accomplishments to Date**
 - Delivered Visualization in Industry paper
 - Delivered Collaboration study
 - Demonstrated constellation telemetry generation for an arbitrary constellation
 - Delivered REACH Build 1 (ZUI Integration, Data Carousel Final Version, Design Health Modeling)
 - Delivered REACH Build 2 (Filtering and Sorting on Visualizations, Heterogeneous Paper Prototypes, Prototype Health Modeling)
- **FY01 Plan vs. Actual Deviations**
 - Actual work has proceeded on plan
- **Planned Accomplishments for FY02**
 - Task was scheduled to complete in FY03
 - Task is cancelled

Information Visualization (InVision)



InVision Jini Object Information Network (JOIN)

Overview

- **Summarized Description:**

- Provide a virtual single point of access to a dynamic multitude of service providers
 - Provide a domain specific user interface, or portal
- Provide capabilities on top of the OTS Java Jini technology:
 - Enable service providers to easily *join* a federation
 - Provide security within the now physically distributed system
 - Provide a mechanism to define domain specific metadata which describes each service provider

- **Background / Need:**

- Mission Ops costs can be reduced by consolidating services and virtually distributing the service providers at optimal locations (i.e. the CSOC MSD concept)
- Java Jini is an ideal underlying architecture to provide this capability, but it is a low level technology (not an application) which can not just be used out of the box.
- The JOIN project is assessing the new Jini technology, learning how best to leverage it, and developing the necessary higher level services on top of Jini

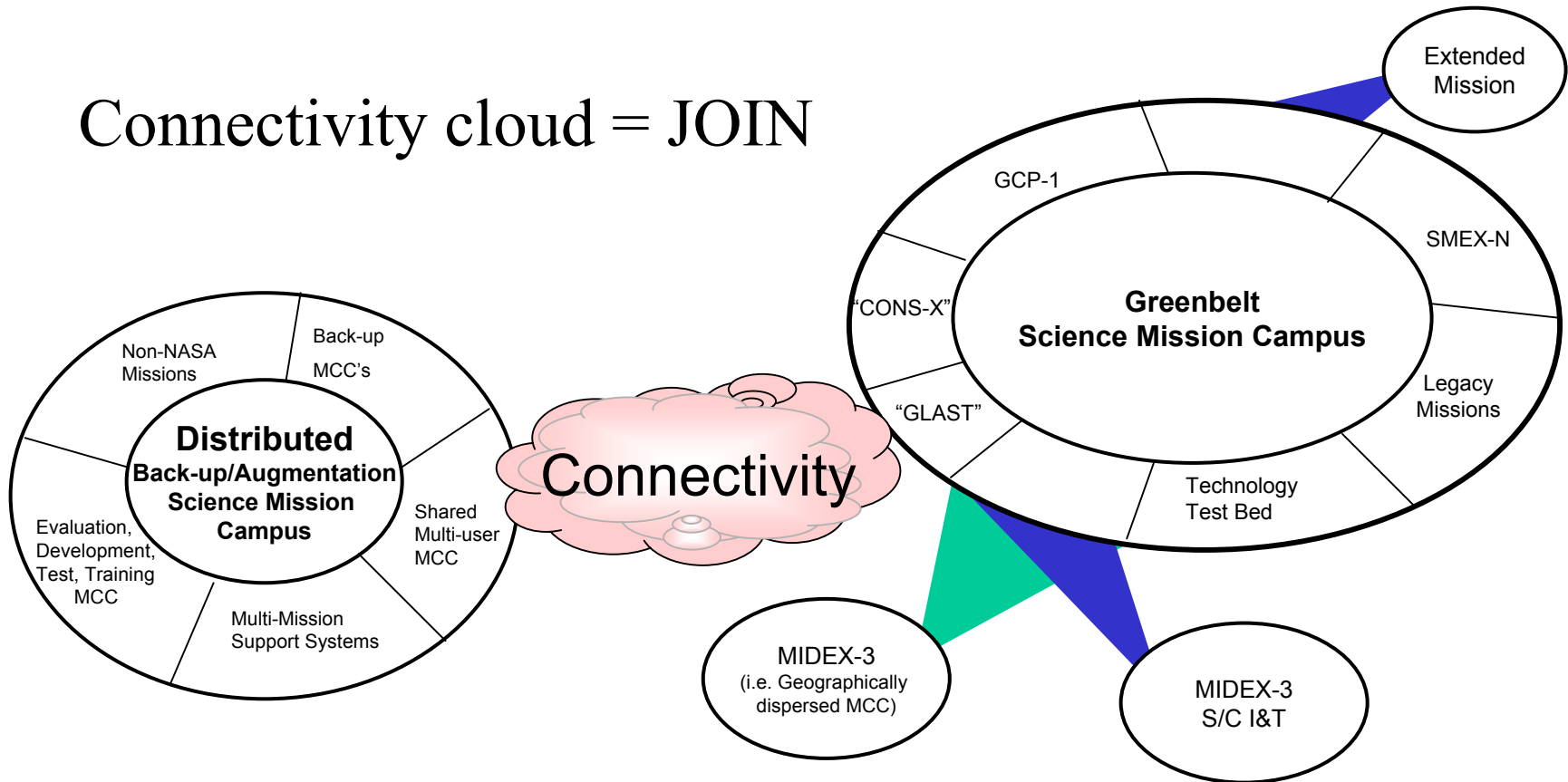
- **Benefits:**

- Reduce mission operations costs via the MSD paradigm
 - Consolidated services
 - Distributed services

- **Potential Customers: Code 900**

CSOC Virtual Campus MSD Slide

Connectivity cloud = JOIN



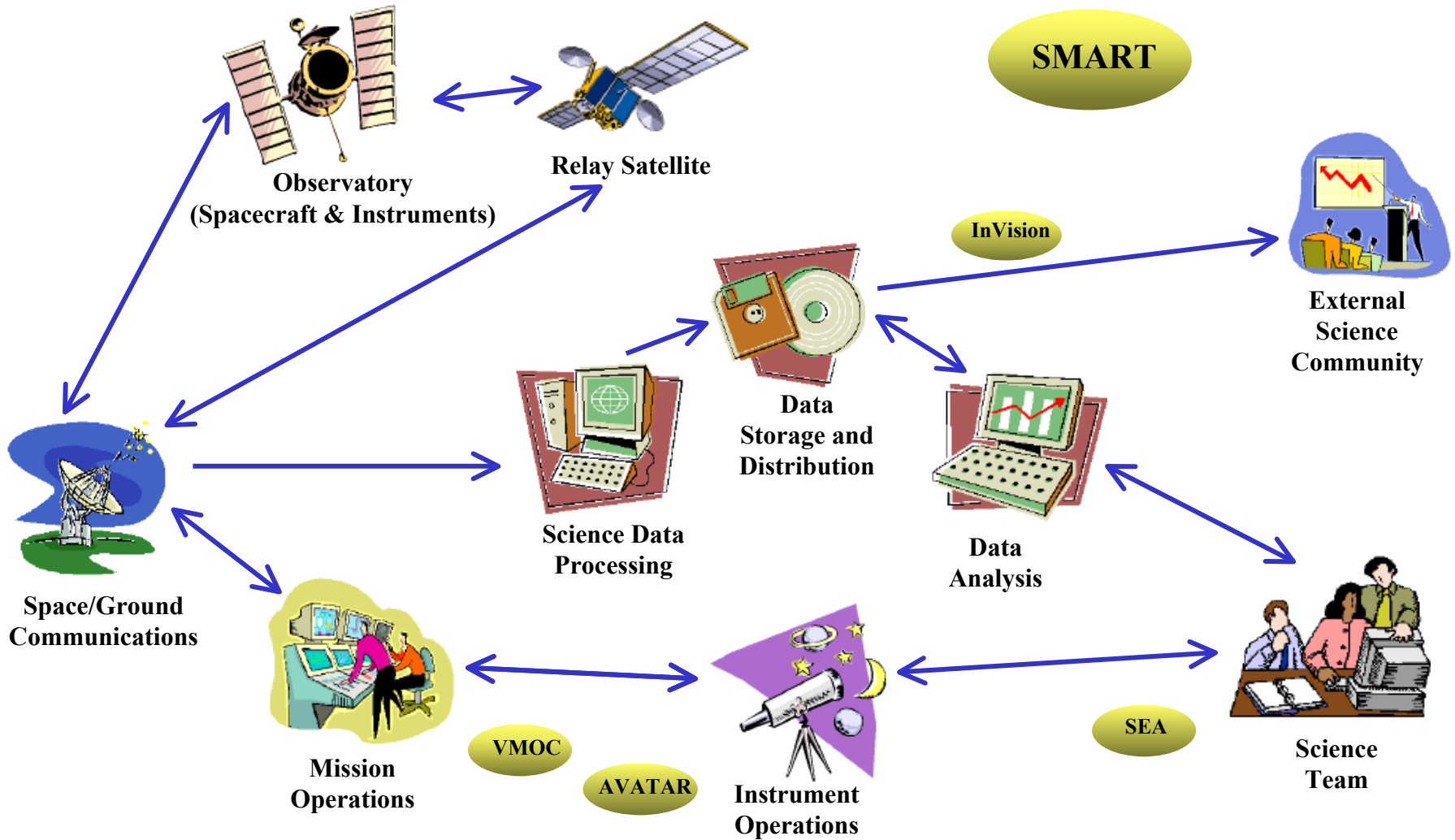
- Heterogeneous solutions responsive to the needs of the individual customer
- Virtual campuses achieved via. connectivity – Not via. facility(ies)
- Yields some “centralized goodness” and establishes GSFC partnership

InVision JOIN

FY01 Accomplishments / Plans

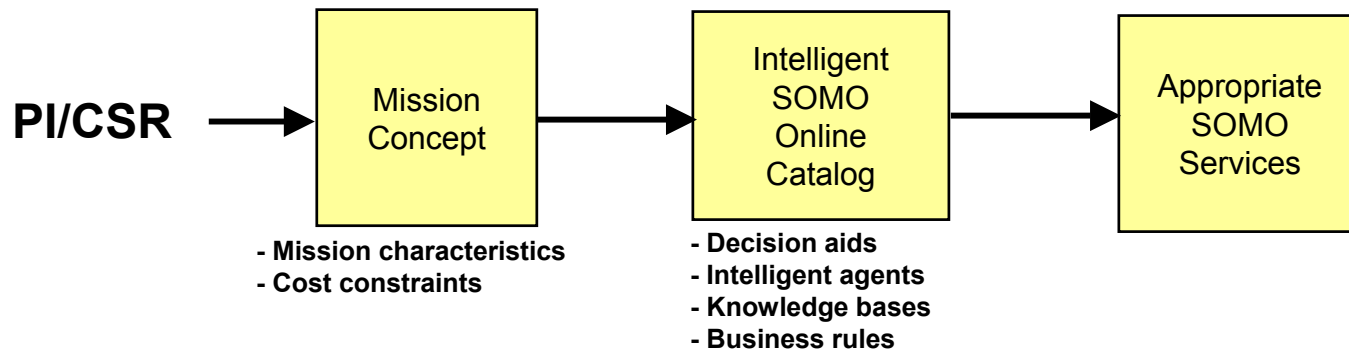
- **FY01 Accomplishments to Date**
 - Demonstrate JDL Proof-of-Concept
 - Completed Design Document
 - Deployed Project and Portal mock-up web site
 - Completed initial JOIN prototype (generic architecture)
 - Completed Build 1 – Network Data Servers
- **FY 01 Plan vs. Actual Deviations (since semi-annual review)**
 - Build 2 – New Contributors “JOIN” network was cancelled in order to complete documentation and clean up of code in preparation for being cancelled at the end of the fiscal year.
- **Planned Accomplishments for FY02**
 - Task is complete
 - JOIN has received \$180K infusion funding from CIO and some SBIR and NSF funding for FY02

Scientist's Mission Assistant and Research Tool (SMART)



Scientist's Mission Assistant and Research Tool (SMART) Overview

- **Summarized Description:**
 - Demonstrate the concept of using intelligent software agents that apply SOMO “Business Rules” and decision aids to help Customer Service Representatives (CSRs) and Principal Investigators (PIs) create Service Requests (SRs) more quickly, more completely, and with fewer errors.
- **Background / Need**
 - The current SOMO Standard Services Ordering Tool (SSSOT) does not contain any validation mechanism to determine if the appropriate services have been ordered in a service request. Development of a limited proof-of-concept Intelligent Service Validation Agent (ISVA) prototype to provide this validation meets an immediate need of the SSSOT. Also, adding intelligent software agents and Customer Relationship Management (CRM) concepts is aligned with the long-term vision of the SSSOT.
- **Benefits**
 - Provides dynamic feedback to the users about the completeness and correctness of the SR being created
 - Allows the user to be more effective and efficient in creating a SR
 - Increases the user satisfaction of the SSSOT
 - Could reduce the necessary CSR staff
- **Customer: Users of SOMO SSSOT**



SMART ISVA Overview

Intelligent Service Validation Agent (ISVA) Prototype - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: <http://aaaprod/Smart/ISVA/ServiceRequest.cfm?selectedSR=31&operation=Edit&myAction=ValidationResults> What's Related

SOMO

**SOMO Standard Services Ordering Tool (SSSOT)
Intelligent Service Validation Agent (ISVA) Prototype
Edit Service Request (SR)**

PSLA Code: 31
PSLA Title: Terra
Customer Type: NASA
Enterprise: Y
Lead Center: GSFC
Current POP: NO

Service Type: Data Service Class: Compatibility Test Support

Service:

- 2.6.3.01 - Compatibility Test Van
- 2.6.3.02 - Compatibility Test Trailer
- 2.6.3.03 - Compatibility Test Laboratory
- 2.6.3.04 - DSN Testing Facility
- 2.6.3.05 - Merritt Island Compatibility
- 2.6.3.06 - Radio Frequency Simulation Operations Center
- X.IOA06M - PCD-6 PACOR Automation - M

Add Service

Delete?	Service ID	Service Title	Units (FY2001)	Units (FY2002)	Units (FY2003)	Units (FY2004)	Units (FY2005)	Units (FY2006)	Units (FY2007)
<input type="checkbox"/>	1.2.1.14	Flight Operations On-Orbit - D	0.0	0.0	12.0	12.0	3.0	0.0	0.0
<input type="checkbox"/>	1.2.2.03	Orbit Determination Complex, Attitude Dependent	53.0	53.0	57.0	65.0	16.0	0.0	0.0
<input type="checkbox"/>	1.2.2.11	Spacecraft Ephemerides Ballistic	6.0	6.0	6.0	6.0	2.0	0.0	0.0
<input type="checkbox"/>	1.2.2.12	Spacecraft Ephemerides Maneuver Modeling	384.0	384.0	396.0	420.0	105.0	0.0	0.0
<input type="checkbox"/>	1.2.2.36	Trajectory Analysis Planning Aids, Event Predictions	53.0	53.0	57.0	65.0	16.0	0.0	0.0
<input type="checkbox"/>	1.2.3.06	Science Data Processing Class F	12.0	12.0	12.0	12.0	3.0	0.0	0.0

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SMART ISVA

FY01 Accomplishments / Plans

- **FY01 Accomplishments to Date**
 - Demonstrated ISVA Prototype Version 2 to SSSOT developers
 - Defined the Requirements for integrating ISVA with the SSSOT
 - Presented & demonstrated ISVA to the GSFC CSRs
 - Completed initial Knowledge Capture with the expert CSRs.
 - Delivered ISVA Releases 1.0, 2.0, and 3.0 to the SSSOT developers for infusion into the SSSOT
 - Supported integration testing with SSSOT developers
 - Delivered SSSOT enhancement builds 1 & 2 to SSSOT developers for infusion into the SSSOT
- **FY 01 Plan vs. Actual Deviations**
 - All work has proceeded as planned.
- **Planned Accomplishments for FY02**
 - Task was scheduled to complete in FY02
 - Task is cancelled

Software Engineering Lab

Mike Stark

Software Engineering Laboratory

Overview

- **Summarized Description:**

- The Software Engineering Laboratory (SEL) performs research into software development processes and technologies, develops improved software engineering techniques based on this research, and transfers these improvements to software development organizations at GSFC. The effectiveness of new technology is demonstrated by measurable improvements in the cost and quality of software delivered to Earth and Space Science missions.
- EXAMPLE: Applying knowledge management technology to software development

- **Background / Need:**

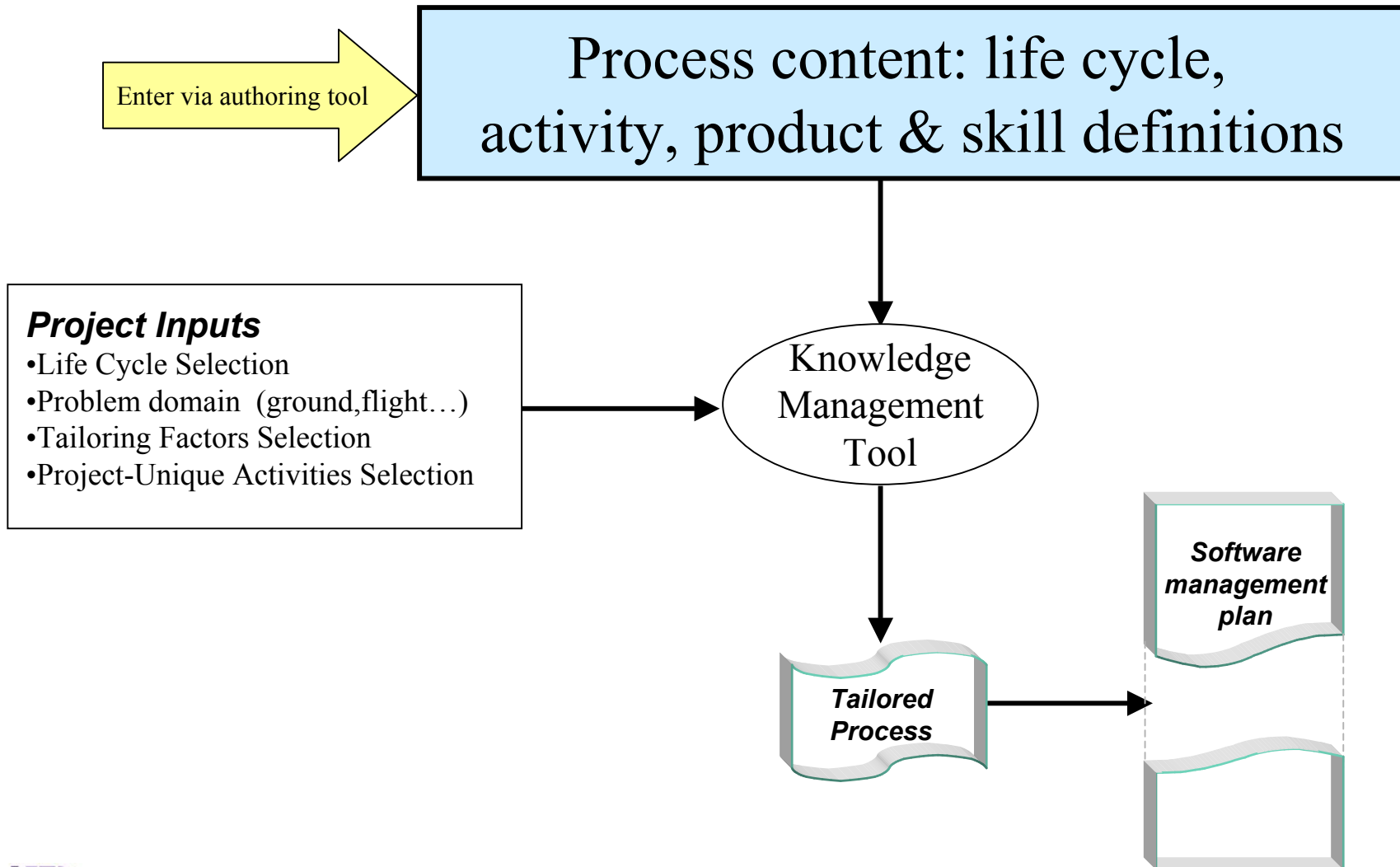
- Quotes from NASA CIO slides, April 12, 2000 (as presented to NASA Senior Management Council by Lee Holcomb)
 - “Complexity/size of software is growing faster than our ability to produce or manage it”
 - “Software has contributed to significant mission problems/failures”
- Motivates need for understanding, assessing, documenting, and automating effective software development techniques

- **Benefits / Metrics:**

- Development process tailorable to specific project needs to maximize effectiveness and minimize overhead
 - Decreased development cost
 - Increased quality of delivered products (reliability, usability, performance,...)

Software Engineering Laboratory Overview

Knowledge Management Tool Concept



Software Engineering Laboratory Overview

FY01 Changes

- **Large cut (\$500K) has following impact in FY01**
 - Training course development halted
 - Metrics tool work halted
 - COTS studies halted
 - November 2001 Software Engineering Workshop cancelled
 - Flight software product line research halted
 - NEXUS cancellation also influenced this
 - Alternate product line work (trending domain) is using funds earmarked for IV & V Center
- **Remaining scope: process engineering activities leading into**
 - Bulk of work is appropriate to continue under NASA Software Initiative (OCE); some delays in deployment activities
 - Proposal for research into knowledge management tool for automating selection and use of software development techniques

Software Engineering Laboratory

FY01 Accomplishments / Plans

- **FY01 Accomplishments to Date**
 - Deliveries of on-line process documentation for use by ISO team
 - Initial development process 12/1/00
 - Initial maintenance process 1/24/01
 - Update 3/16/01 -- revision in accordance with review by GSFC ISO stakeholders
 - Update to Data Collection & Reporting System requirements 1/26/01
- **FY 01 Plan vs. Actual Deviations**
 - Work was de-scoped in response to funding cut (see previous slide)
- **Work in 2nd half of FY01**
 - **Delivered** draft GPG 8700.5, “In-House Development and Maintenance of Software Products” for final approval
 - Expansion of process engineering work to GSFC level
 - Work toward defining acquisition process
 - Initial drafts
 - Interviews with software managers involved with acquisition
 - Refine process
 - This work is being picked up by GSFC’s Process Improvement Project in FY02

User Tools for Autonomous Systems

Milestone Schedule

	Start Date	End Date	Revised End Date	Notes
5821 - Virtual Mission Operations Center (VMOC) Task				
1.1 Advanced SERS Delivery/Infusion		2Q FY01		
1.2 Operations Process White Paper	1Q FY01	1Q FY01		
1.3 High bandwidth Options White Paper	1Q FY01	1Q FY01		
1.4 Data Storage White Paper	1Q FY01	2Q FY01		
1.5 COTS Collaboration Tools White Paper	1Q FY01	2Q FY01		
1.6 Proof of Concept Prototype	2Q FY01	3Q FY01		
1.7 Beta Tests at Remote sites	3Q FY01	4Q FY01		
1.8 Deliver Release 1 of the SERCE		4Q FY01		
1.9 JAS Release 1.0 (basic concepts)	3Q FY00	1Q FY01		
1.10 JAS Release 2.0 (operational release)	1Q FY01	3Q FY01		
5822 - Advanced Visual Tools and Architectures (AVATAR) Task				
2.1 Report on other industry efforts	4Q FY00	1Q FY01	2Q FY01	#1
2.2 Build 1 prototype (ZUI Integration, Data Carousel Final Version, Design Health Modeling)	3Q FY00	2Q FY01		
2.3 Build 2 release (Full Filtering and Sorting on Constellation Visualizations, Heterogeneous Paper Prototypes, Prototype Health Modeling)	2Q FY01	4Q FY01		
5823 Information Visualization (InVision) Task				
3.1 Requirements Review		1Q FY01		
3.2 Design Review		1Q FY01		
3.3 Cataloging Tool for Populating and Archive	3Q FY00	2Q FY01		
3.4 Initial JOIN prototype (generic architecture)	4Q FY00	2Q FY01		
3.5 Interface Portal/Search Capabilities	2Q FY01	3Q FY01		
3.6 Build 1 - Network of Data Servers	2Q FY01	3Q FY01		
3.7 Build 2 - New contributors "JOIN" Network			Cancelled	#2

	Start Date	End Date	Revised End Date	Notes
5824 – Science Mission Assistant and Research Tool (SMART) Task				
4.1 SSSOT Enhancement requirements definition	4Q FY00	1Q FY01		
4.2 ISVA Prototype Version 2 - Requirements issues focus	4Q FY00	1Q FY01		
4.3 SSSOT Enhancement Design	1Q FY01	2Q FY01		
4.4 ISVA Release Version 3 - Design issues focus	1Q FY01	2Q FY01		
4.5 SSSOT Enhancement Build 1	2Q FY01	3Q FY01		
4.6 SSSOT Enhancement Build 2	3Q FY01	4Q FY01		
5825 - Scientist's Expert Assistant (SEA) Task				
5.1 Simulation Release 1 (simulation framework)	1Q FY01	1Q FY01		
5.2 Simulation Release 2 (first-order target, instrument, environment, detector models)	2Q FY01	2Q FY01		
5.3 Simulation Release 3 (integrate with SEA proposal browser UI)	3Q FY01	3Q FY01		
5.4 Simulation Release 4 (support for spectroscopy visualization)	4Q FY01	4Q FY01		
5.5 Simulation Release 5 (remaining simulation models)	4Q FY01	4Q FY01		

	Start Date	End Date	Revised End Date	Notes
5826 - Software Engineering Laboratory (SEL) Task				
<i>Process Engineering</i>				
Updates to ISC Library of Approved Processes				
6.1 Update #1	1Q FY01	2Q FY01		
6.2 Update #2			Cancelled	#3
6.3 Update #3			Cancelled	#3
6.4 Initial CMM Process Assessment for ISC			Cancelled	#4
6.5 Metrics Tool completed			Cancelled	#4
6.6 Preliminary knowledge management tool study	1Q FY01	2Q FY01	3Q FY01	#5
<i>COTS Studies</i>				
6.7 Cost estimation study report			Cancelled	#4
<i>Product line framework for flight software</i>				
6.8 Flight Software product prototype report			Cancelled	#4
Flight Software product line process document				
6.9 Draft			Cancelled	#4
6.10 Final			Cancelled	#4
<i>SEL Quality Improvement Approach technology transfer</i>				
6.11 25th Annual Software Engineering Workshop				
6.12 Training Plan (Curriculum)			Cancelled	#4
6.13 1st increment of measurement & experimentation training			Cancelled	#4

Notes:

- Project was directed to do an alpha software build.
- Cancelled due to termination of task in FY02
- Replaced with delivery of draft GPG8700.5, "In-House Development and Maintenance of Software Products"
- Cancelled due to the budget cut
- Lead investigator (Dr. Scott Henninger of U of Nebraska, visiting U of MD) was on extended travel